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Description

[FILM SURFACE FINISHING SYSTEM]

BACKGROUND OF INVENTION

[0001] *Field of the Invention*

[0002] This invention provides a film for finishing a surface, surfaces finished with the film, and methods for finishing a surface with the film.

[0003] Floor care programs today are primarily used to both protect and enhance the appearance of a floor substrate, such as vinyl, marble, terrazzo, ceramic, linoleum, wood, etc. floor substrates. Floor care programs can include many different types of products, but generally involve the use of a sealer and/or finish applied to the surface of the floor substrate. This finish is then maintained with the use of cleaners and tools, which can include various buffing or burnishing machines. Although these programs are very effective, they are considered a large expense to customers. Additionally, if a surface becomes worn or unsatisfactory over time, it is necessary to entirely remove the

floor substrate, to provide a new fresher look to the floor.

[0004] Polymer-based floor coatings are an example of finishes that are typically applied with a mop as an aqueous emulsion or solvent solution that dries to a hard protective film. After months of exposure to traffic, such finishes become scratched, scuffed and soiled to a point where they need to be completely removed from the floor and a new finish applied. The removal of these coatings from hard floors has traditionally required the use of corrosive chemical solutions, typically mixtures of alkalis and volatile solvents. These chemical mixtures are generally unpleasant and messy to use. Also, because of their hazardous nature it is generally recommended that users wear protective goggles, gloves and footwear. There is further concern that these liquid mixtures may create slippery floors and an increased risk of slip and fall accidents. They also present potential environmental and hazardous waste issues. As a result of these issues and the amount of time and labor involved, recent trends in protective floor coatings are to move away from these traditional finishes and move toward more durable, highly crosslinked coatings, such as UV-cured urethanes, polyurethane dispersions and epoxies. These coatings,

while they have enhanced durability over more traditional floor finishes, suffer in that they, too, eventually have to be removed from the floor due to scratching, scuffs, etc. However, while more traditional floor finishes can be removed chemically, the highly crosslinked nature of these durable films makes them difficult, if not impossible to remove by any means other than physical abrasion.

[0005] In summary, a considerable number of deficiencies exist in the art relating to finishes for indoor and outdoor surfaces, such as floor surfaces, wall surfaces, ceilings, driveways, sidewalks, patios, and the like.

[0006] Thus, there is an ongoing search for a surface finishing system which would enable a surface to be finished partially or in its entirety, which can be quickly and easily applied yet is readily removable and resistant to scratches, scuffs, gouges and other damage by maintenance equipment and general wear and tear.

SUMMARY OF INVENTION

[0007] One aspect of the invention provides a flexible surface finishing film. The film may be transparent or opaque and may be a colored film. The film may serve to facilitate the removal of overlying top coats, including cured top coats, by peeling the film away without the need for any strip-

ping agents or other chemicals. Other optional layers include a bonding coat for attaching the film to a surface, at least one removable protective layer for protecting the film and/or any bonding coat prior to the application of the film to a surface, and a release coating between the film and the removable protective layer. The bonding coat may be selected to attach the films in a removable or repositionable manner.

[0008] Another aspect of the invention provides a floor finishing system which includes a flexible finishing film and a surface onto which the film is to be applied. Optionally, the system may also include at least one top coat applied over at least a portion of the film. The system may additionally include at least one base coat applied to the surface prior to application of the flexible film to the surface. The film in such a system is desirably sufficiently thin to provide a minimal difference between the height of the surface without the film and the height of the surface having the film applied thereon. In some embodiments, the film is disposed on at least a portion of the surface whereby the remaining portion of the surface is devoid of film. In other embodiments, the film is applied over the entire surface.

[0009] The inventive system also optionally includes a surface

cleaner for cleaning a surface to which a finishing film has been applied. Such cleaners include neutral cleaners, alkaline cleaners, acidic cleaners, cleaner/maintainers and maintainers, including polymeric type cleaners.

[0010] In practice, application of the surface finishing film to a surface comprises the following steps. It is advisable, but not required, that the surface be properly cleaned prior to the application of the film to remove dirt or debris which may adversely affect the overall appearance of the film covered surface. It is desirable, but not necessary, to leave a thin film or mist of the cleaners on the surface as a wetting agent or to apply a thin layer of wetting agent to the film prior to applying the film to the surface. The next step involves positioning or disposing the film on at least a portion of the surface. For example, this may involve rolling the film onto the surface beginning at one edge. After such positioning, a top coat, such as a crosslinked finish, may be applied over at least a portion of the film. In some embodiments a base coat layer may be applied to the surface after the cleaning step but prior to positioning the film on the surface.

[0011] In certain constructions, the flexible surface finishing film is strong enough that it may readily be removed from the

surface simply by peeling the film away from the surface.

Brief Description of Drawings

[0012] FIG. 1 shows a flexible surface finishing film applied to a floor.

Detailed Description

[0013] The present invention is directed to flexible surface finishing films used to finish and protect a surface and to surface finishing systems that include the films. The films are desirably pre-formed polymer films.

[0014] The present invention has potential applications on any surface where protection, scuff-resistance or slip-resistance is desirable. Such surfaces may be found both indoors and outdoors. These surfaces include floors, walls, ceilings, roofs, patios, shelves, and stairs, and ground cover structures, such as roads, driveways, and sidewalks. The surface to be finished may be made from a vast variety of materials, including, but not limited to, vinyl, marble, terrazzo, ceramic, linoleum, wood, metal, plastic, rubber, gypsum board, plaster, concrete, stone, vinyl composition tile, and glass.

[0015] FIG. 1 shows an exemplary embodiment of the invention. As shown in FIG. 1, a floor finishing system may include a

flexible film *20* at least partially covering a surface *24*. The surface finishing system of FIG. 1 further includes, a bonding coat *26* disposed against the lower surface of the film *20*, and a top coat *34* applied over the top of the film. A base coat *28* is also shown in FIG. 1, sandwiched between the surface to be finished *24* and the bonding coat *26*. Initially, the present invention can include removable protective layers (not shown) above the film *20* and below the bonding coat *26*. The upper removable layer is designed to protect the upper surface of the film *20* and the lower removable layer is designed to protect the lower surface of film *20* and/or any bonding coat *26* applied thereto. Although not shown in the figure, the structure may also include a release coat between the upper removable layer and the upper surface of the flexible film and/or between the lower removable layer and the lower surface of the flexible film or any bonding coat applied thereto.

[0016] In some embodiments, the flexible film facilitates the removal of an overlying top coat from the surface. The flexible film may be selected and designed such that the film, along with any overlying layers disposed thereon, may be readily removed by peeling the film layer away from the

surface, either in a single sheet or in smaller pieces. This eliminates the need for conventional stripping agents and makes the removal process, less expensive, less energy intensive, and less time consuming. It also eliminates the need for stripping chemicals which pose a hazard to both the user and the environment.

[0017] The flexible film is desirably thin enough that the thickness of any seam between the surface and the film is minimized. In some embodiments, the film has a thickness of 25 mils or less, 10 mils or less or 8 mils or less. This includes embodiments where the film has a thickness of 6 mils or less, embodiments where the film has a thickness of 4 mils or less, embodiments where the film has a thickness of 2 mils or less, embodiments where the film has a thickness of 1 mils or less and embodiments where the film has a thickness of 0.5 mils or less, where a "mil" is defined as one one-thousandth of an inch. The choice of film thickness will depend, at least in part, on the intended application and location of the film. Additionally, the type of film will impact the film strength. Thus, it may be possible to utilize films of particular materials in a thinner dimension while maintaining sufficient strength to be peeled away from the surface without tearing or with

only minor amounts of tearing. A thinner film might be more desirable where it is imperative that the transition from the surface to the film be nearly imperceptible. Alternatively, a thicker film might be used to smooth out an underlying surface that is uneven, rough, or damaged.

[0018] The flexible film may be made from any material suitable for providing a protective layer on an underlying surface. Examples of suitable materials for the film include, but are not limited to, fabrics, foils, polymeric sheeting, and paper. Specific examples of suitable polymeric sheeting materials include, but are not limited to, polypropylene films, polyacetal films, polyamide films, polyanhydride films, polyester films, polyolefin films, polystyrene films, polyvinyl chloride films, polyvinylidene chloride films, polyurethane films, polyurea films, and the like.

[0019] As noted above, the present invention may optionally include a bonding coat on the lower surface of the film as shown in FIG. 1, where the lower surface of the film is the surface that will be face down with respect to the surface to be finished once the film is applied. Such a bonding coat is made from an adhesive which serves to adhere the flexible film to the surface. The tackiness of the adhesive may vary over a broad range depending on the intended

application of the film. As used herein, the term "tack"refers to the rate at which an adhesive bond forms between two surfaces. As one of skill in the art will recognize, the tack of certain adhesives may be influenced by the thickness of the adhesive layer. In embodiments where it is desirable to provide a surface finishing system wherein the film is readily removed from the surface, the adhesive should be selected such that it bonds preferentially to the film, rather than the surface to be finished. In certain embodiments the tack of the adhesive will range from 50 to 2000 grams per square centimeter. This includes embodiments where the tack of the adhesive ranges from 100 to 1500 grams per square centimeter, and further includes embodiments where the tack of the adhesive ranges from 150 to 1000 grams per square centimeter.

[0020] The bonding coat is desirably thin in order to minimize the combined thickness of the bonding layer and the film. In various embodiments, the combined thickness of these two components is 8 mils or less, 6 mils or less, 5 mils or less, 4 mils or less and even 2 mils or less. Suitable adhesives for use in the bonding coat include pressure sensitive adhesives. In some embodiments, the pressure sensi-

tive adhesives are non-curing adhesives or adhesives that do not require curing after application, because such adhesives may be more easily removed from some surfaces. For example, in some embodiments, curable epoxies are avoided. Other suitable adhesives include temperature sensitive adhesives, repositionable adhesives, or any other suitable adhesive known to one of ordinary skill in the art. Examples of suitable pressure sensitive adhesives include, but are not limited to those disclosed in U.S. Patent Nos. 4,845,149; 4,879,333; and 4,923,919, the disclosures of which are incorporated herein by reference.

[0021] The adhesive may be applied directly to the lower surface of the film or may first be applied to the surface of a protective removable layer, of the type described below, which is then disposed adjacent to the lower surface of the film, sandwiching the adhesive coating between the film and the removable protective layer. In this embodiment, it is advantageous if the adhesive bonds preferentially to the film such that it is transferred along with the film onto the surface to be finished. The bonding coat may be applied to the surface of the film or the protective layer by any conventional means. For example, the adhesive may be spray coated, rolled or printed onto the film

or protective layer. In some embodiments, the adhesive dissolves readily in mild detergents. Alternatively, the adhesive may be applied directly to the surface to be finished, or a portion thereof, and the film may subsequently be adhered to the adhesive.

[0022] In some embodiments, the bonding coat may be omitted. For example, an external source may be utilized to maintain the position of the film on the surface to be finished during application of a top coat over at least a portion of the film such that the top coat secures the film to the surface. Alternatively, the film may have enough tack to adhere to the underlying surface without the use of additional adhesive.

[0023] As noted above, the film may optionally include a removable protective layer disposed above and/or below its upper and lower surfaces. A release coating may be included between the upper removable protective layer and the upper surface of the film. In some embodiments, a lower removable protective layer is disposed next to the lower surface of the film. In such applications, a bonding coat as described above, may be included between the removable protective layer and the film. In this construction the removable protective layer serves to prevent debris from

collecting in the adhesive and to prevent the adhesive from attaching to a surface prematurely.

[0024] The upper and lower removable protective layers may be made from the same or different materials. Suitable materials include, but are not limited to, plastics, such as polyester, polypropylene, or polyethylene. The removable protective layer or layers may optionally be transparent materials. In some embodiments the removable protective layer or layers are made from paper which may optionally be coated paper. This has the advantage of significantly lowering the cost of production of the surface finishing films. In addition, because the paper may be readily recycled, this embodiment saves energy and reduces waste.

[0025] Suitable materials for use in release coats are well known and include, but are not limited to, polyvinyl chloride and acrylics designed to facilitate the release of the removable layer or layers from the film. The release coat may be designed to remain substantially adhered to the removable protective layer after the transfer of the film to the surface to be finished. Alternatively, the release coat may be designed to remain substantially adhered to the film after the transfer. In the latter design, the release coat is referred to as a breakaway coating. The breakaway coating

should be selected and designed such that it does not substantially affect the thickness of the applied film. In other embodiments, the release coat is split between the film and the removable protective layer upon the removal of the latter. In various embodiments, the combined thickness of the film, any bonding coat, and any release coating is 8 mils or less, 6 mils or less, 5 mils or less, 4 mils or less, or even 2 mils or less.

[0026] After the application of the surface finishing films to the surface to be finished, at least one top coat may be disposed over at least a portion of the upper surface of the film. The top coat may be any conventional sealant or finish and may be applied as a solid or a liquid top coat. The top coats may be cured top coats. As used herein, a "cured" coating includes coatings that are formed by the evaporation of a solvent and the coalescence of the solid film without crosslinking (i.e. "evaporatively-cured"coatings) and coatings that are formed by crosslinking reactions. Such top coats are well known and commercially available and are generally used to impart shine, dirt resistance, water resistance, and/or scratch/wear resistance to the surface. Examples of suitable top coats include polishes, waxes and metal cross-linked

(reversible cross-linked) finishes. The top coat may help adhere the film to the surface to be finished and to further smooth out the edges of the film. However, the top coat is not required.

[0027] Suitable commercially available cured floor finishes for use with the floor finish systems provided herein include Signature, a metal interlock styrene-acrylic finish that cures at ambient temperatures, available from JohnsonDiversey, Inc. (Racine WI). Suitable commercially available evaporatively-cured floor finishes include ZF-175, Linobase, and JX-4000, available from JohnsonDiversey, Inc. (Racine, WI). Conventional floor finishes mixed with crosslinking hardeners may also be employed. For example, Signature may be mixed with about 1% polyaziridine to provide a more durable crosslinked finish.

[0028] For many applications, such as floor applications, it is desirable for a surface finish to provide a slip-resistant surface or a surface having a single coefficient of friction which helps prevent trips, slips and falls. In some instances, the flexible film may provide a sufficiently slip-resistant surface, however, when it is desirable to increase the slip-resistance of the film, a top coat which provides a coefficient of friction higher than that of the film may be

applied over at least a portion of the film. In some embodiments the top coat may provide a non-slip surface. As used herein, a "non-slip" surface is a surface having a coefficient of friction of at least 0.5 as measured by ASTM D-2047, a standard test method for determining the static coefficient of friction using the James Machine Test. This includes embodiments where the top coat provides a surface having a coefficient of friction of at least 0.55, further includes embodiments where the top coat provides a surface having a coefficient of friction of at least 0.6, still further includes embodiments where the top coat provides a surface having a coefficient of friction of at least 0.65, yet further includes embodiments where the top coat provides a surface having a coefficient of friction of at least 0.7, and even further includes embodiments where the top coat provides a surface having a coefficient of friction of at least 0.75.

[0029] Examples of suitable top coats include, but are not limited to, durable crosslinked polymeric top coats, such as crosslinked acrylic finishes. The combination of an underlying flexible film with an overlying crosslinked polymeric finish provides a durable surface coating that can be removed simply by peeling the flexible film away from the

surface. This represents a significant advantage over surface coatings where a crosslinked finish is applied directly to a surface. These crosslinked surface coatings generally can only be removed by physical abrasion. Specific examples of crosslinked top coats that may be applied over the flexible films include styrene acrylics, urethane acrylics, urethanes, vinyls, epoxys, and the like. These crosslinked finishes include permanent finishes, where a "permanent"finish is a finish that cannot be removed from an underlying substrate, such as a floor surface, without mechanical abrasion. For example, in some embodiments, the top coat is made of a finish that is not alkali-soluble. The finishes may be cured by inducing crosslinking under ambient temperatures ("ambient-curable finishes") or with the aid of an external heat or energy source ("energy-curable finishes"). As used herein, the phrase "energy-curable finishes"includes both radiation curable finishes and heat curable finishes. In various embodiments, the combined thickness of the film and any top coat is 8 mils or less, 6 mils or less, 5 mils or less, 4 mils or less, or even 2 mils or less. However, it is not imperative that the top coat be particularly thin.

[0030] The crosslinked top coats may be applied over the flexible

film as a composition containing one or more curable monomers or polymers, such as acrylic, urethane, vinyl or epoxy monomers or polymers, in a solvent, desirably an aqueous solvent. The composition may optionally include other additives that assist with the application or curing of the composition, such as dispersants, curing-agents, crosslinking agents, photoinitiators, leveling aids, emulsifiers, silicones, waxes, pigments, dyes and preservatives. Once the composition has been applied to the flexible film, it is allowed to cure. In some cases, it is exposed to energy (heat or radiation) to induce curing. The selection of an appropriate energy will depend on the nature of the finish. Suitable energy sources include heat sources, infrared energy sources, ultraviolet energy sources, radiowave energy sources and microwave energy sources, or a combination thereof. Energy curable surface (e.g. floor) finishes are well known and commercially available. UVInfusion, UltraTc and Ultra Rock, available from Minuteman International (Addison, IL), are examples of durable UV crosslinking floor finishes that may be used in the floor finishing systems provided herein. Joncryl 1972 and Joncryl 1980 are examples of durable self-crosslinking floor finishes that may be used in the floor finishing systems

provided herein.

[0031] As noted above, at least one base coat may be disposed between the surface to be finished and the film. Suitable base coats are well known and commercially available. The base coat can be of different, similar or identical composition to the top coat, as previously discussed.

[0032] Further embodiments of the present invention allow for a first surface finishing film to be applied to a surface, followed by the application of a top coat over at least a portion of the first surface finishing film, and the subsequent application of a second surface finishing film disposed on top of the top coat, optionally followed by an additional top coating. Further, alternating layers of flexible films and top coats can be utilized to achieve a desired effect. In such an embodiment, as in previous embodiments, a base coating layer can be disposed on top of the surface to be finished prior to application of the first surface finishing film. The ability to provide multiple layers of films is advantageous because it allows the lower films to be patched in order to fix holes or cover damage.

[0033] In readying the surface for application of a surface finishing film, it is recommended, but not required, that the surface initially be cleaned or stripped to remove dirt, de-

bris or similar waste, as well as any inferior coatings applied on the surface. Conventional cleaners including neutral cleaners, alkaline cleaners, acidic cleaners, cleaners/maintainers, or maintainers including polymeric cleaners, may be utilized for this purpose. One such cleaner is UHS Cleaner, available from JohnsonDiversey, Inc. (Racine WI). Dust mopping, or similar light cleaning may be utilized to remove the majority of the dust and dirt. After cleaning and stripping, the film may be positioned on or rolled out onto the surface. If the film is packaged with one or more removable protective layers, those layers are removed, exposing the film or the bonding coat, if present, and the film is applied to the surface, typically by applying light pressure. The film may be applied beginning at one edge by adhering an edge of the film to the surface, using any adhesive coated on the lower surface of the film or a strip of tape, and spreading (e.g. rolling) the film outwardly from that edge, pressing it onto the surface as it spreads. A tool having a flat edge may be utilized to uniformly apply the film to the surface and remove any bubbles, wrinkles, etc. Such tools include, rubbing sticks, rigid blades, flat-bladed squeegees, T-bars, including weighted T-bars and rollers, including heated and/or weighted rollers. Any

bubbles remaining in the film after application may be removed by pricking the bubbles with a pin or similar object to release trapped air or liquid. After the film is suitably placed and positioned on the surface to be finished, any remaining removable layers may be peeled away. Next, a top coat may be disposed over at least a portion of the film. Multiple layers of the top coat may be applied.

[0034] Alternatively, a water release or water slide technique can be utilized to position the film on the surface whereby the film is positioned above the surface and moisture is applied to slide the film off of a removable protective layer and onto the surface.

[0035] The inventors have surprisingly and unexpectedly discovered that bubbles in the film may be reduced or eliminated by first applying a thin layer or mist of a liquid wetting agent having a surface tension equal to or lower than that of water, to the surface to be finished, or to the lower surface of the film prior to the application of the film to the surface. For example, water may be used as a wetting agent. For some applications, a wetting agent having surface tension lower than water is desirable. This includes applications where the wetting agent has a surface tension of no more than about 70 dynes/cm at 20°C, further

includes applications where the wetting agent has a surface tension of no more than about 65 dynes/cm at 20°C, still further includes applications where the wetting agent has a surface tension of no more than about 60 dynes/cm at 20°C and even further includes applications where the wetting agent has a surface tension of no more than about 50 dynes/cm at 20°C. Suitable liquid wetting agents include conventional cleaning solutions including alcohol-containing cleaners, acidic cleaners, alkaline cleaners, and maintainers. A conventional floor finish (e.g. an aqueous formulation with suspended solids) may also be used as a wetting agent. Such a finish may be applied as a mist or a thin liquid coating, and the flexible film may be applied over the finish before it dries to reduce bubble formation in the film.

[0036] Bubbles may also be reduced by using an air or liquid permeable film or by using a film that has one or more perforations to allow any liquid or air trapped below the film to escape as the film is flattened onto the surface. The perforations may include holes of various shapes, however narrow slits or pin holes are preferred because they allow air and liquid to escape without significantly reducing the smoothness of the film. This is desirable be-

cause a rough surface may wear out faster as dirt collects in rough areas and edges become frayed. Thus, the number of perforation is desirably sufficient to reduce the number of bubbles without unnecessarily roughening the surface of or weakening the integrity of the film. In some embodiments, the films have an average of at least 1 perforation per square foot. This includes embodiments where the films have an average of at least 10 perforations per square foot. In some embodiments, the films have an average of no more than about five hundred perforations per square foot. This includes embodiment where the films have an average of no more than about two hundred perforations per square foot, further includes embodiments where the films have an average of no more than about one hundred perforations per square foot and still further includes embodiments where the films have an average of no more than about fifty perforations per square foot.

[0037] In embodiments where a cured or crosslinked top coat, of the type discussed above is employed, it is desirable to provide a film that prevents or minimizes leakage of the top coat through the film and contact of the top coat with the underlying surface and/or any underlying bonding

layer where it may form a permanent finish that cannot simply be peeled away from the surface. In these embodiments, the film may have only a small number or perforations, may include only perforations presenting small openings, such as slits (rather than holes) or pin holes, or may be non-perforated. Where the small opening approach is used, the openings should be sufficiently small to prevent or substantially prevent the top coat from passing through.

[0038] The flexible films may be provided in sheets or rolls and may be applied as a single sheet or in multiple smaller film segments. The film segments may take on a variety of shapes, but desirably include one or more straight edges. Suitable shapes include rectangles and squares. When multiple film segments are laid down they are desirably disposed adjacent each other with edges in contact, but not overlapping. This process may be facilitated using a laser-guided chalk line to help establish straight rows and clean butt joints.

[0039] Maintenance of a flexible film-finished surface according to the present invention, may be handled by utilization of commonly used cleaners, including neutral cleaners, alkaline cleaners, acidic cleaners, polymeric cleaners and

polymeric maintainers. Commonly available products such as Stride Cleaner, available from JohnsonDiversey (Racine WI), can be utilized. After the cleaner is applied to the surface, an agitating force sufficient to remove dirt without damaging the film may be applied. This may be accomplished with commonly used mechanical tools such as auto-scrubbers and buffers.

[0040] It should be noted that the layer thicknesses depicted in FIG. 1 are for illustration purposes only and are in no way meant to reflect the actual thickness of each layer or its relative thickness with respect to any other layer.

[0041] While the principles of this invention have been described in connection with specific embodiments, it should be understood clearly that these descriptions are made only by a way of example and are not intended to limit the scope of the invention.